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## THE DISEASE OF NEW YORK AND ITS REMEDY.

A communication from Mr. Wm. Paul Gerhard, Civil and Sanitary Engineer, Newport, R. I., came to hand too late last week to admit of more than an acknowledgement of its receipt. We propose to reply now more fully.

Mr. Gerhard thinks that the separate system of sewering cities introduced into this country as he says, by the author of the *Scribner* article on the "Disease of New York and its Remedy," "deserves a more earnest review, and a fairer criticism than the sweeping remarks in the article signed W.," and adds, that he "does not think the profession can derive any benefit whatever from reading articles full of personal remarks such as the one in question." As we have indorsed "W," and are responsible for all he says in this matter, we propose to consider this charge of personality.

A man of the prominence in his works and writings as is claimed for the author of the "Separate System of Sewerage in this Country," cannot expect immunity from criticism for all time because he has measurably escaped it in the past. His writings as well as his works are, to a certain extent, public property; and if his works do not, from their paucity, furnish dimensions sufficient to justify attack, possibly his writings may not be open to the same objection, but cover so much ground as to be readily assailable. Read from page 71 to 76 of *Scribner* of May, 1881, and bearing in mind the physical horrors depicted so graphically, with much of even greater significance vaguely hinted at, and think of the mental condition of a population made aware of all this, and yet tied down by inexorable fate to their pestilential homes to meet the approach of all the unknown evils which can possibly result from such surroundings; and that there may be no question that the entire city, with its 350 miles of sewers, is in this very condition, it is stated (p. 71) "that it is universal, and unavoidable in all works of 'combined' sewerage."

Now, with such a formidable disease before us, in all its varied phases, what shall we say of the system, which, in the year 1881, of the nineteenth century, is declared as the remedy, and the only remedy, through the application of which this city "may yet enter upon a new and vigorous life, untrammeled by the bondage of preventable disease, and fearless of preventable death." Can it be called other than "quackery?" And just so far as the writer in *Scribner* identifies himself with and adheres to this prescription as the *only* remedy for the sanitary ills of New York, just so far has "W." dealt in personalities and no further.

With reference to needless alarm being kept up, permit us to cite a single illustration: On page 74 it is stated, referring to the Bartholomew, or pan closet, "that it might have originated with the devil, that is totally unfit to be used within the walls of any dwelling house." And an illustration is given exhibiting its accumulated and magnified horrors as inseparable from the machine. Now it is probable that at least six hundred thousand of the inhabitants of this city use no other, and never saw any other. What would be the condition of these people if this machine was as deadly as it is made to appear? That the picture is overdrawn and too highly colored, or, in other words, a false alarm created, we all know. The writer has lived in a salubrious country village, where there was neither sewer, water-closet nor house piping of any kind, and suffered in his family from zymotic disease—a subsequent residence in a city house for 25 years, with no other fixtures than the condemned pan closet, without a single case of the long list of some 35 or 40 preventable diseases attributed to sewer air ever having occurred in his family; and this is not a solitary case by any means. The fault is not in the fixture, as the alarmist would have us suppose, but in its misuse. What purpose then is served by the outcry against it, but to create a needless alarm? And who profits by this alarm?

We are told that "the sanitary engineer does not devote his life to philanthropy, and is entitled to proper remuneration for his services." Doubtless this is so, and we are far from endeavoring to undervalue his *real* services, but we object to the course of some of them in creating an imaginary disease to give proper effect to an equally imaginary remedy.

It is true that the separate system has been proposed by English sanitarians even for large cities, but it is equally true that it has never been accepted as a remedy for all the evils resulting from the attempt to remove human refuse from crowded areas by the water-carriage method.

As early as 1856, when the subject of sewering London was under advisement, the separate system was advocated, and its merits maintained by several engineers of reputation, among others, Samuel Hughes, who estimated the plan of Bazalgette (the one carried out), then before the Committee, to cost $14,500,000 and his own plan $21,400,000, but considered the advantages of the separate system to more than compensate for its increased cost, if carried out in London; and though this system was urged with some force, the Committee unanimously reported adverse to it in the following words:

"We have carefully observed the condition of the London streets; the water which usually flows from them, more especially during rainy weather, contains fine organic matter to a serious extent, and there is, in point of fact, no such difference between metropolitan surface drainage and house sewage as to justify the one being removed from the river, whilst the other is still permitted to flow into it. Again, the rain falling on the roofs and yards of buildings in the metropolis is subject to a vast amount of contamination, and there is much objectionable matter washed out of the yards of manufactories, and from the various stables, mews, cow-houses and other places, during rain; in numerous instances the house gutters are immediately outside the attic windows, and into these quantities of slops, etc., are constantly discharged; the pipes from the water closets and sinks of many houses are also connected with the rain water pipes, which are made use of as the regular soil pipes for these houses.

"Professor Way has analyzed samples of street waters intercepted in their passage to the sewers, and states that it would 'be as valuable in a manuring point of view as the ordinary contents of the sewers.' * * * 'And such a system of pipes, if carried out, would be as difficult to maintain in working order as to construct, and could not, we feel confident, be maintained in its integrity.' 'We have already mentioned, that it is customary now in many houses for the waste pipes from the sinks to be connected with the rain-water pipes; and it is difficult to imagine any system of inspection, which, in the event of the separate system being established, would prevent a householder, or the builder, or workmen employed by either of them, from joining the house-drains to the sewer for rainfall, and vice versa, if by so doing expense could be saved or inconvenience avoided; nor could such mistakes be prevented from occurring through negligence or ignorance.'

* * * * * * * * *

"For these several reasons, we are of opinion that it is inexpedient, and, indeed, would be most injudicious to provide a plan for the drainage of the metropolis which should separate the house sewage from the rainfall."

Some villages and hamlets have adopted it successfully in England, following the "boom" in favor of small pipes, in view of the existing elongated cess-pools of that date, but it has not extended materially. The furore for the extremely small pipes having subsided, when it was practically demonstrated, that the surface water of crowded cities was as good "sewage" as the waste water from the dwellings, and the necessity for its prompt removal, which the small pipes could not effect satisfactorily, equally a matter of necessity.

The circumstances which rendered it apparently applicable to the city of Memphis in our own country, were the obvious *necessity* for something being done forthwith, and that the funds available for the purpose were inadequate for any other—the surface water in that city being allowed to take care of itself. It was either that or nothing. Entirely misapprehending the peculiar circumstances of the locality, an engineer (Mr. C. H. Latrobe) has recommended it for the city of Baltimore basing the recommendation, as we understand, largely on the presumed success attending its working in Memphis, coupled with the suggestion of utilizing the sewage on a large scale by irrigation; and thus, as he says, "the city will derive a considerable revenue from its sale." And it is this idea of utilizing the sewage which underlies the entire scheme of the separate system. Without the sewage can be utilized as manure in some form, there exists no call for preserving it separate from the surface water; and the separate system falls to the ground.

Mr. Latrobe has taken an entirely one-sided view of this question of utilization. With our present knowledge of the subject, the sewage of a large city can neither be manufactured into solid manure at a profit, nor can it be utilized on sewage farms, with *profit to the city*. It should be borne in mind in this connection, that save in exceptional cases the extent of what may be called virgin soil in our country, even in the neighborhood of large cities, is so great that the liquid manure (the only form offering a shadow of return) transported from cities, must of necessity be confined to rearing kitchen garden produce, and at no great distance, and never the great staples of the agriculturist. As to the vegetable gardens, the suburban railroads will bring more savory table vegetable from the upland grounds in the neighborhood, and from greater distances and fully as cheap, as the sewage drenched products of any waste lands contiguous to cities; and whether from mere prejudice or not, our housekeepers will pay more for the former than this latter—as they will for butter rather than oleomargarine, although the chemical constituents of the latter may be proved to be identical with that of butter.

We would not appear as hypercritical, but Mr. Gerhard, with the best intentions possible, will be doing much harm to the plumber himself by attempting to elevate on paper the trade and occupation of plumbing into a "profession." The plumber works under the direction, or should do so, of the Sanitary Engineer; and, however well qualified he may be—and some of them doubtless are, as we happen to know, fully capable of acting as Sanitary Engineers—yet in view of the course of study and the training required of the practical plumber he should be considered as still in the ranks—not of a "profession," but of a handy-craftsman—from which, by his genius, he may hope some day to expand into a full-blown Sanitary Engineer—but not that such a course is strictly and essentially in the line of promotion.

## THE PANAMA CANAL.

There is no longer concealing the melancholy fact that the preparatory surveys for the Panama Canal have already cost the lives of a large proportion of the engineers engaged. There is undoubtedly too much partisan feeling or rather *parti pris* in the lay press on the subject. The French organs present every thing connected with the canal in *couleur de rose*, but recent events must tend to greatly dampen their enthusiasm in a project in which France is more financially than commercially concerned. A writer, who seems to

be an engineer, has a very scathing article on the Panama Canal in a recent number of the Zurich publication, *Die Eisenbahn*. The following is a résumé of his statements: He charges the company with almost a total lack of sanitary arrangements on the isthmus. Men were sent to the interior without beds or tents, and very often without engineering instruments. The successive batches of engineers were sent more to aid the placing of the shares of the company than to perform any useful work. Nothing can, however, be attempted, for no line for the canal has yet been laid out—the line of Wyse and Reclus being made from an old map of Col. Totten's, and is simply an absurdity from a technical point of view. A few soundings have been made in the *probable* axis of the canal, and this is all. The deaths of Bionne and Etienne are alone spoken of, but no mention is made of those of Geladon de Montfaucon, Dziembowski, Ostinelli, Bertrand, Drussel, Tellier, Barbier, Dumouriez, Darelle, Toussaint, Persona, etc., most of whom were in charge of departments. Medical attendance was insufficient—the doctors often coming, like the carabineers of Offenbach, "when all was over." The bodies of engineers were brought in coffins to the grave, but there the corpse was taken out of the coffin and buried in a pit, like the dead of the battle-field.

Unfortunately, the numerous deaths sufficiently prove the murderous nature of the climate, and the news received this week of the death of Blanchet has opened the eyes of all to the fact that "going to Panama" is a proceeding which should be preceded by settling one's affairs and making a will.

Blanchet was the head and soul of the surveys at the canal, and he had only just returned from France. He was born in Algeria, and after long experience in the service of the Ponts et Chaussées he became connected with Couvreux & Hersent, the eminent contractors. He had charge of the works for regulating the Danube, and was employed at the various important contracts undertaken by Couvreux & Hersent. He had just explored the Upper Chagres River and its confluents, discovering some very valuable woods, which could be used for the purposes of the canal, when the fatal fever attacked him.

Proper drainage, which follows civilization and commerce, may yet change the climatic conditions of the Isthmus wonderfully; but in the meantime the undertaking promises to use up a great many valuable lives—a great deal of engineering talent.

## POLLUTION OF BOSTON WATER SUPPLY.

At the regular meeting of the Board of Aldermen of Boston, on Nov. 15, the following orders were passed:

"Ordered, that his honor the Mayor be requested to petition the General Court, at its next session, for such additional legislation as may be necessary, in the opinion of the officers of the law department, to prevent the pollution of the water supply of Boston.

"Ordered, that the Boston water board be directed to take immediate action toward developing the full capacity of the Sudbury River water supply.

"Ordered, that the Boston water board be directed to cleanse the present storage basins and to remove therefrom all material that, in the opinion of the city engineer and other experts, tends to pollute the water supply.

In the discussion that followed the presentation of the above it was stated that an expert is now making an investigation as to the cause of the bad taste and odor of the water furnished the city.

The bad taste and odor which infect Boston water seem to be intermittent in their visits and to closely resemble in their actions those of Albany, Poughkeepsie, Baltimore and elsewhere. Their presence has been noted at different times during the past few years, and thus far the efforts of experts heve failed to locate their source, prevent their appearance or accomplish their removal.

In a report by the then city engineer, Mr. J. P. Davis, dated May 1, 1876, we find that early in October the water board received complaints that the Cochituate water tasted badly and was unfit for use. As in other cities this taste seemed to have characteristics which entitled it to the distinctive appellation of "cucumber taste," and by this title it became known and recognized. The taste finally became very wide-spread, yet it was noticed that it was free or nearly so in districts where there was little circulation in the pipes, as in some parts of Dorchester, where the residents reported that the water received by them was unusually clear and sweet.

On Oct. 23 samples were taken from the lake, at various points and at all depths, but no trace of the taste was perceptible. Some samples taken where the water was shallow, or at points near the bottom, had the earthy taste peculiar to pond water, but most of them were clear and tasteless. Three days later the Brookline and Chestnut Hill reservoirs were visited, but the water was found to be pure. Samples taken from the Chestnut Hill reservoir in front of the screens of the efflux gate-house were tasteless; but those taken from behind them or from the mouth of the outlet pipe had the cucumber taste in a slight degree. On the next day it was found that the taste had spread through all parts of the Bradlee basin of the Chestnut Hill reservoir; one night being sufficient to contaminate a volume of water of 500,000,000 gallons. It is probable that the high wind which accompanied a thunder-storm during the interval and the violent agitation of the water resulting therefrom aided in developing and diffusing the taste. This reservoir was immediately shut off from the distribution and in a short time the supply was free from the bad taste. This located the evil, or as the report states, showed "that the conditions necessary to develop the taste existed there." On the night of Dec. 3 the gates were opened sufficiently to let three or four millions of gallons into the distributing pipes, but the effect was so disagreeable that they had to be closed on the following day.

This taste gradually disappeared, and on April 1 the gate was again opened without causing any change in the water delivered.

We now come to the most important part of the report, which we quote:

"Prof. William R. Nichols, of the Massachusetts Institute of Technology, was requested to make thorough investigation to ascertain the cause of the trouble, that its recurrence might be prevented if possible, and he engaged Mr. Edward Burgess, Secretary of the Boston Society of Natural History, and Dr. W. G. Farlow, Assistant Professor of Botany in Harvard University, to aid him. These gentlemen have made a very complete study of the matter, but are unable to assign any cause for the taste."

We hope the endeavors now being made will be crowned with the most favorable results, as the solution of the problem in this case may throw light upon similar cases which are now shrouded in darkness.

[From the Boston Traveler, Nov. 22.]

Prof. Ira Remsen, of Baltimore, who has just concluded a microscopical and chemical analysis of the water in the supply basins, in order, if possible, to determine the cause of the contamination, says that the cucumber taste is owing to the decomposition of a species of fresh water sponge which grows abundantly in Farm Pond, and imparts a disagreeable taste and odor to the water. This sponge Prof. Remsen first discovered on the screens at the Farm Pond gate-house. The odor was suggestive of the cucumber taste much intensified, and as considerable quantities of it were deposited on the screens, it was analyzed and was found to contain the contaminating elements. The City Engineer, who now has entire control of the water supply, intends to excavate a channel in the bed of Farm Pond, which will connect with the gate-house at the upper and lower ends, so that the water from basin No. 2, or Sudbury River, can be run to the Sudbury River conduit, and thence to the city, without mingling with the contaminated water in the pond. Work upon the channel is already under way, and it will soon be completed. As this will only be a means for temporary relief, it is probable that a permanent conduit will be built across or around Farm Pond as soon as this is practicable, so that in case of further trouble, each of the reservoirs can be completely isolated.

## THE NEW DRY DOCKS AT THE ERIE BASIN.

On Red Hook Point, Brooklyn, are two dry docks which are being rebuilt and enlarged, and which, when completed, will be the largest of their kind in this country. These docks were originally constructed by Boston capitalists and remained in their control until quite recently, when they were purchased by New York parties who are now carrying on the work.

Some twenty years ago the waters of New York Bay covered nearly all that portion of Red Hook Point in the vicinity of the present Erie Basin. The land was submerged to a depth of about six feet and the work of reclaiming was initiated by private individuals. The flats were filled in, the basin was protected by a massive sea wall, piers were built around the inner edge, store houses sprang into existence, and as the depth of water had been made sufficient to float the largest vessels that could pass the Sandy Hook bar, a large foreign trade was soon drawn to the neighborhood. Mr. James E. Simpson selected this locality as a favorable site for a dry-dock and was commissioned to construct two docks in accordance with his patents. Nearly two years were required to build them, the cost being $1,500,000. When completed they were pronounced to be the best of their kind in this country and so pleased were the directors of the company (then known as the Erie Basin Dock Company) that they presented Mr. Simpson with a check for $5,000. Dock No. 1 was opened for business in 1866 and No. 2 in the following year. Their dimensions were as follows:

| | No. 1. Feet. | No. 2. Feet. |
|---|---|---|
| Length on coping | 487 | 500 |
| Length on floor | 450 | 467 |
| Width on coping | 124 | 100 |
| Width on floor | 56 | 45 |
| Width of entrance | 90 | 100 |
| Draught of water | 17 | 22.7 |

A little over three years ago the company decided to make a number of alterations in No. 2, the larger dock. Shortly after these had been finished, at an expense of $500,000, an accident occurred which in a moment swept away the work of years and nearly demolished the entire structure. A small stream of water was one morning discovered running through the earth at the bottom of the coffer-dam built across the mouth of the dock. The stream rapidly increased in volume until the coffer-dam was undermined, when it gave way with a crash, letting in a roaring torrent that tore up everything in its course, tossed heavy timbers about like straws, and sent a shower of spray and splinters whirling far inland. Dock No. 1 was somewhat injured, and was allowed to fill with water. No attempt was made to rebuild or repair, and the docks remained a burden on the company's hands until last February, when the property was bought by a number of New York capitalists, who organized under the name of the Anglo-American Dry Dock and Warehouse Company. This company secured the services of Mr. Simpson, and eight months ago began to rebuild the docks on an enlarged scale, so that No. 2, when completed, will contain any vessel in the world and her cargo, excepting the Great Eastern.

The method of building one of these docks is well illustrated in this case, as the work, with the exception of the excavating, is shown in all its details.

As the basin was filled with water, a coffer-dam was built across its mouth, in order to shut off communication with tide-water. After the water had been pumped out, a row of piles was driven along the center of the basin from one end to the other. These constitute the foundation upon which the bolted timbers forming what is known as the keelson rest, and upon which in turn the vessel to be repaired is balanced upon her own keel. Brace piles are driven on the sides of the basin from top to bottom for the support of the wooden walls of the dock. Around the entire basin sheet piling is driven—unless the nature of material encountered render this unnecessary—to a sufficient depth in the earth, thus forming a perfect cut-off and preventing the passage of any water. The space between this cut-off and the water, which enters through openings. This operation requires about three-quarters of an hour. When the water within has reached the same level as that without, the openings in the gate are closed and the water which forms part of its ballast is pumped out. In a short time the gate floats out of the grooves and is towed to one side while the vessel is being floated in, when it is towed back, water pumped into it, and it gradually sinks to its resting place. The grooves are rubber lined, so that a water-tight joint is formed by the pressure of the external water. The water in the dock is then pumped out, the vessel placed on an even keel, and held in position by the bilge chocks. For pumping out water there are two engines of 250 horse-power each, and two Cataract pumps with a suction diameter of 30 inches.

MAP OF GEORGIA PACIFIC RAILWAY.

brace piles is filled with material taken from the basin when deepening, which is rammed hard, thus forming a perfect union with the ground floor, which has also been puddled, the whole being water proof. The dock increases in width from the bottom to the top at an angle of 45°. The brace piles support the altars or steps, which run from the top to the bottom of the two sides and one end of the basin, thereby affording a convenient means of descent to, and ascent from, the dock floor. Upon each side of the entrance to the dock are two massive abutments, protected from the water by strong sheet piling. As the safety of the entire structure depends upon these, they are built in the strongest possible manner and thoroughly protected. The gate fits into grooves running down the inclined sides of the abutments and across the floor of the dock. The gate is of iron and ballasted with stone and water. Running through the sides of the gate, below low-water mark, is a number of culverts, or openings, which can be closed by means of valves, when it becomes necessary to prevent inward flow of water in order to empty the basin. In docking a vessel the dock is first filled with

The dimensions of the docks, as reconstructed, are as follows:

| | No. 1. Feet. | No. 2. Feet. |
|---|---|---|
| Length on coping | 500 | 6 0 |
| Length on floor | 450 | 550 |
| Width on coping | 124 | 120 |
| Width on floor | 56 | 50 |
| Width of entrance | 85 | 85 |
| Draught of water | 20 | 25 |

The Brooklyn docks have been leased for a term of 15 years by the firm of William Cramp & Sons, ship and engine builders, of Philadelphia.

## THE GEORGIA PACIFIC RAILWAY COMPANY

The Richmond & Danville Railroad Company was chartered March 9, 1847; and the main line was opened for traffic May 16, 1856, and the branches in 1871-74. It now has a capital stock of $4,000,000, and controls 2,053.3 miles of railroads in operation.

Of this mileage the Richmond & Danville Company controls directly 827 miles by ownership and lease, and controls indirectly 1,226.3 miles through its ownership of a majority of the capital stock of the Richmond & West Point Terminal Railway and Warehouse Company, a corporation which was chartered by the State of Virginia and authorized to purchase the stocks, bonds and other securities of any railroad in the States of Virginia, North Carolina, South Carolina, Tennessee, Kentucky, Georgia, Alabama or Mississippi, and to own and control railroads in those States by purchase, lease or otherwise. This step was rendered necessary from the fact that the charter of the Richmond & Danville Company, while authorizing the purchase or lease of connecting railroads, did not authorize the general purchase of the stock of roads not directly connecting with it, and hence when it became desirable for it to obtain the control of certain Southern roads for the purpose of extending its main line, as well as secure lateral feeders, the Richmond & West Point Terminal Railway and Warehouse Company was organized. The Richmond & Danville Company secured the control of this corporation as above stated.

Shortly after its organization this corporation secured the control of various railroads in the South aggregating 729 miles, and it subsequently acquired other valuable properties, the most important being the Virginia Midland Railway.

The Richmond & Danville system has all rail connections north over its Virginia Midland Railroad, which road, under agreements with the Pennsylvania and the Baltimore & Ohio, runs its trains from Alexandria, Va., into Washington and Baltimore. Its deep water connections are from Richmond, Va., *via* the James River, and from West Point, Va., *via* the York River. It has its own steam service from West Point and Richmond to Baltimore, and has steamship connections from these points to New York and the East. From Alexandria, Va., the line extends through Lynchburg; and from West Point, Va., the line runs through Richmond, the two uniting at Danville, Va. From Danville the main line extends south over the North Carolina Railroad to Char-

lotte, N. C., and there divides; one line, the Charlotte, Columbia & Augusta Railroad extending to Augusta, Ga.; another, the Atlanta & Charlotte Air Line Railway, extending to Atlanta, Ga.

The feeders south of Danville comprise that part of the North Carolina Railroad from Greensboro, through Raleigh, N. C., to Goldsboro; the Northwestern North Carolina Railroad, from Greensboro to Winston, N. C.; the Western North Carolina Railroad and branches, the main line extending from Salisbury, N. C., through Asheville to Paint Rock, Tenn.; the Atlantic, Tennessee & Ohio Railroad from Charlotte to Statesville, N. C.; the Columbia & Greenville Railroad, which connects the two cities south of Charlotte by a cross line between Columbia & Greenville, S. C.; the Spartanburg, Union & Columbia Railroad, from Alston, on the Greenville road, to Spartanburg, on the Atlanta & Charlotte Air Line; the Asheville & Spartanburg Railroad, from Spartanburg, S. C., to Henderson, N. C.; the Blue Ridge Railroad, which is part of the Columbia and Greenville system, from Walhalla to Anderson Court House, crossing the Atlanta & Charlotte Air Line at Seneca City; the Laurens Railroad, from Newberry, on the Columbia & Greenville road, to Laurens Court House, and two other branches of the Columbia & Greenville Railroad, one from Hodges to Abbeville and the other from Belton to Anderson Court House, where it connects with the Blue Ridge Railroad.

The Atlanta & Charlotte Air Line has the following feeders: The Northeastern Railroad of Georgia, which extends from Lulu station to Athens, Ga.; the Elberton Air Line, from Toccoa station to Elberton, Ga.; the Laurenceville (ten miles); the Roswell (nine miles) and Hartwell Railroad, from Bowersville, on the Elberton Road, to Hartwell, near the Savannah River.

The Western North Carolina Railroad will be completed from Salisbury to Paint Rock, a distance of 186 miles, with a branch from Asheville to Pigeon River, during the present month. This road will connect at Paint Rock with the East Tennessee, Virginia & Georgia system, thus opening a new line to and from the West and Southwest for the whole territory comprised in the Richmond & Danville system.

This system traverses the States of Virginia, North Carolina, South Carolina and Georgia, embracing within the territory covered by it the rich tobacco and cotton-growing sections of these States, and passing through the capital cities and many of the most thriving towns of each.

Thus the parent line, the Richmond & Danville Railroad, has secured the control of a system of 2,053 miles of completed railroads.

The Georgia Pacific Railroad will run from Atlanta west to Birmingham, Ala., which will be a junction for connecting roads north and south; from this point the line as surveyed and projected will traverse the State of Alabama in a westerly direction, passing through Columbus or Aberdeen, in Mississippi, near the line dividing the States of Alabama and Mississippi; and thence through Greenville or Arkansas City, where the Mississippi River will be crossed to Texarkana, its terminus, at that point connection will be made with the Texas Pacific road direct to El Paso, and thence by the C. P. Huntington Southern Pacific route to San Francisco and cities along the western slope.

The connection for the Pacific Coast by the new route at Birmingham is midway between Nashville, Tenn., and Vicksburg, Miss. It has not yet been decisively determined whether the road will pass through Greenville and Columbus, Miss., or, turning north, benefit Aberdeen and Arkansas City in the same State. For 100 miles of the route of this road through Georgia, whose capital city is becoming so great a factor in the forwarding of Southern interests, the surrounding country is rich in coal and iron, which have hitherto found their only markets in the southern tier of cities—Mobile and Montgomery, Ala., and other towns, owing to the lack of transportation facilities except north and south, which was the favorite direction chosen by former projectors of railroads in the South; while the cities to the east and west—Atlanta, Greenville and others—have been practically cut off from any accruing benefit.

The Georgia Pacific scheme will bring these fields to within 110 miles of Atlanta, and at a little longer distance will give them a market in Greenville and cities west, besides opening a natural and easy route to the Mississippi River and thence to New Orleans and contiguous cities in Mississippi, which at present and heretofore have relied for their supplies of fuel on the coal fields of Pennsylvania, through Pittsburgh. A direct line east and west, avoiding the former circuitous routes north through Kentucky to St. Louis, and thence west by the Central Pacific, has been long an obvious need; and this the present project seems calculated to supply.

The Georgia Pacific Railroad is being built by the Richmond & Danville Extension Company, a corporation organized under the laws of the State of New Jersey with a capital of $5,000,000. The Richmond & West Point Terminal Railway and Warehouse Company has subscribed for fifty-one per cent. of the Richmond & Danville Extension Company, and thus controls the enterprise. It will thus be seen that the Richmond & Danville Railroad Company, by virtue of its ownership of a majority of the stock of the Richmond & West Point Terminal Railway and Warehouse Company, controls the entire system.

The map which we publish elsewhere will convey an accurate idea of the location of the various parts of this system and of the most important lines which it intersects.

The officers of the Georgia Pacific Railway are: Gen. John B. Gordon, President; Mr. A. S. Buford, Vice-President; Mr. H. C. Ansley, Secretary, and Maj. R. H. Temple, Chief Engineer, with headquarters at Atlanta, Ga.

The New York office of the Richmond & Danville Extension Company is at No. 145 Broadway, room 7.

## FLOW OF WATER IN OPEN CHANNELS*

BY THEO. G. ELLIS, M. A. S. C. E., HARTFORD, CONN.

A very valuable report of the Roorkee experiments has been recently published by the government of the Northwest Provinces of India, in three octavo volumes—one of text, one of tables and the other of plates.

The experiments were commenced under the superintendence of Capt. Cunningham (who has since been promoted to be Major) in December, 1874, and were continued until March, 1879. They were made upon the Ganges Canal, near Roorkee, and the work was assisted as far as practicable by the Thomason College of Civil Engineers, and the whole report was printed at the college press. This gave Major Cunningham, who was an officer of the college, ample advantages for the preparation of the work and the correction of the proofs; so that the published report is a marvel of typographical accuracy for such a work. The parts of the canal upon which the experiments were made were mostly of uniform sections, although in some places they had approached the form of a natural stream. The stations at the Solani Aqueduct comprised a nearly rectangular channel, while the "Fifteenth mile site" presented a bed more similar to that of a river, and the Solani embankment, the Belra, the Kamhera and the Paoli sites were intermediate between them, approximating the form of a canal bed with regular slopes.

Although Major Cunningham possessed the great advantage of the immediate neighborhood of the college, one is immediately struck with the great knowledge of previous experiments shown in the preparation of the work; and the experiments, as well as the deductions drawn from them, have greater weight from having been made after a due consideration of what had been done before.

The experiments were made in channels of from 55 to 185 ft. wide, and having a depth of about 10 ft. Some experiments were also made upon smaller channels of 9 to 16 ft. wide and 3 to 5 ft. deep. The principal instruments used in the gaugings were the double float and the mean velocity rod. It is to be regretted that the double floats employed were not what would be considered of the best form by such American engineers as have had most experience in the use of floats. After pretty thoroughly discussing the subject of double floats, Major Cunningham appears to have adopted one of very objectionable size and form. The first double float, used from 1875 to February, 1876, was a 3-in. wooden ball, connected with a wooden disk surface float, 3 in. diameter and $\frac{3}{16}$ in. thick, by a brass wire .012 in. in diameter. Sometimes a cork surface float 2 in. in diameter and $\frac{3}{16}$ in. thick was used. From February, 1876, to 1879 the lower float consisted of a thin spherical copper shell $1\frac{5}{8}$ in. in diameter. The surface float was a slice of round cork 1 in. in diameter and $\frac{1}{4}$ in. thick. The connecting cord was a black silk thread of $\frac{1}{120}$ in. diameter in 1876–77, and $\frac{1}{80}$ in. diameter in 1878–79. This instrument had a tension on the cord of 30 grains, and a reserve buoyancy of from 6 to 15 grains. The defects of this float are that the ball form is liable to be carried upward in eddies from its having so great a horizontal section, and the preponderance of weight or tension upon the cord is too small either to overcome this upward tendency or to hold the cord in place when passing through currents of different velocities. There has been a correction made for the errors of this float, but the amounts would be variable and uncertain.

The mean velocity rods used were chiefly tin tubes of 1 in. diameter, and were of excellent construction. The system of field work and the manner and times of making the gaugings were unexceptionable. The work was systematically done by trained observers, and the results appear to be carefully worked out. On the whole, the experiments appear to be entitled to more than usual weight, and merit the careful study of every hydraulic engineer.

The deductions made by Major Cunningham from these experiments deserve especial attention. It will be impossible to even mention them in detail; but a few of the more striking conclusions will be named.

The form of the vertical velocity curve is deduced from the observations, and is considered to be as nearly as may be a parabola with the axis horizontal and habitually below the surface; thus agreeing with most of the modern experimenters. Major Cunningham's method of computing the parameters of the parabola by the method of least squares, or greatest probability, is admirable and deserves imitation. One of the great advantages of the mathematical computation of the equation of the vertical velocity parabola is that it admits of a discussion of the form of the curve and the relations of the velocities at different depths to the mean velocity. This has been done, and a formula deduced for three observed velocities, which is sufficient to fix the form of the curve. Four forms

*Roorkee Hydraulic Experiments, by Capt. Allan Cunningham, R. E.

of this formula are given, three of which are useful in practice, the best appearing to be

$$U = \tfrac{1}{6}(3\,v\tfrac{1}{2}\,H + 2\,v\tfrac{1}{2}\,H + 3\,v\tfrac{1}{2}\,H),$$

in which $U$ = mean velocity.

$v$ = velocity at any depth.

$H$ = depth, and $v\tfrac{1}{2}\,H = v$ at $\tfrac{1}{2}$ depth, etc. Four formulas are also given for determining the mean velocity from that taken at two depths, three of which are useful. The best of these is $U = \frac{1}{4}(v_0 + 3\,v\tfrac{2}{3}\,H)$.

This appears to the writer to be the best of all approximation formulas yet suggested, as it involves the surface velocity, which is the easiest measured, and the velocity at $\frac{2}{3}$ the depth, which is a near approximation to the point where the measured velocity would be a mean of the whole curve. It has a great advantage over a formula involving only the mid-depth velocity as for different streams. The mid-depth velocity does not appear to bear any definite ratio to the mean velocity. This formula, however, remains to be tested by the observations upon other streams. If the vertical curve is a parabola it will be correct.

Major Cunningham's discussion of the form and laws of the vertical velocity curves is by far the best that has yet been made, and it is a satisfaction to American engineers to know that he has made use of the methods indicated by the most level-headed of American mathematicians, Prof. M. Merriman, in his "methods of least squares."

The forms of the transverse velocity curves are also investigated, but less satisfactorily than the vertical curves. The form of section of the Ganges Canal gives these curves a different form from any found in natural streams. A wide portion of the bed of nearly uniform depth renders the transverse curves nearly flat in the middle, and the true law of the curve is only developed very near the sides.

Velocity rods having a length reaching nearly to the bottom were largely used in determining the mean velocity. The channels were of a form suited to this method at at least two of the sites, and the direction taken by the rods in floating down the stream seems to have been unusually regular and the variations from a direct line extremely small. Except in rectangular channels, experience has shown that such rods are of no practical value in determining the mean velocity. In natural channels they cannot reach near enough to the bottom, especially near the banks, to give even and approximate mean velocity. Major Cunningham gives a mathematical investigation of the theory of rod motion, and the mean that ought to be assumed by the rod, which is only interesting from its ingenious reasoning. The premises are insufficient. Modern science does not furnish the necessary data to determine the pressures upon different portions of the rod by currents of different velocities. The experiments, however, were admirably conducted, and the results are very valuable. Major Cunningham derives from them the conclusion that the velocities measured by the rods are generally more accurate than can be obtained by the use of double floats.

He also finds that rods of .94 of the depth give the mean velocity of the vertical. This is not in accordance with the experiments of Mr. J. B. Francis, at Lowell, who found that rods of .99 of the depth gave the mean velocity. As Mr. Francis' quantities were taken from measurements over a weir, and his weir formula was taken from actual measures in a tank, it gives an indirect comparison between the tank measurements and Major Cunningham's double float-gaugings, and shows that his method of measurement probably errs in excess. This would also be inferred from the floats employed and his method of computation.

The computations of the quantities discharged from the float gaugings by "Simson's rule," the "cubic rule" and "Weddle's rule" may be admirably adapted to the sites at which the measurements were taken on the Ganges Canal, but they are not so well adapted for natural beds. In these it is often necessary to make soundings across a section much more frequently than the velocity stations can possibly be taken. In this case the bed may be so irregular that the application of the above rules would give only a rough approximation to the discharge, and the accuracy would be only apparent. These rules, although exact for certain curved forms, cannot be at all depended upon for *all* forms, and in some cases a large error will be made while apparently getting great accuracy. Simson's rule "when used for finding volumes," is not "the prismoidal formula," as stated inadvertently by Major Cunningham. To make it so, the even sections would have to be formed by straight lines drawn from the boundaries of the odd sections.

The most interesting part of the work to all hydraulic engineers will probably be found in Chapter XX., upon mean velocity. In it are discussed the relation of the maen velocity to the central surface, mean central and maximum velocities; and it includes an able criticism of the more prominent formulas for the discharge of streams computed from the maen section and slope. This chapter must be read carefully to be appreciated. It is a fair epitome of what is known of formulas for computing the volume of discharge from the slope, and shows conclusively that all known formulas are at best only approximate, and disposes of the matter of an improved formula as follows:—"The great uncertainty of success in formation of these more or less empirical formulæ, the great probability that increased approximation can only be obtained by increased complexity, witness the successive increases of complexity from Chézy's to Bazin's and Kutter's formulæ, and the great labor attending the numerical verification, seem to the author to make further research for an improved *form* of coefficient almost hopeless from the experimental side, *i. e.*, until some help as to the *proper* functional form can be obtained from theory."

Major Cunningham also says further on:

"There can be little doubt that the mean velocity is in some way conditioned by the surface slope, but the law of connection is at present *wholly unknown*, the present formulæ being in fact purely empirical, *resting on no rational basis* and, therefore, *only of limited and uncertain applicability*. The connection between the mean velocity and any particular velocity is indeed also unknown, but there can be little doubt that the connection is a *far more intimate and less complex one* than that between surface slope and velocity."

There are innumerable points of interest in Major Cunningham's work which cannot even be mentioned in a short review like the present; he appears to have fully and entirely understood his subject, and to have carefully read what has been before written, and his work is perhaps in many particulars the most important that has yet been published on the subject. It is a long step in the right direction, and the ability, industry and thorough investigation evinced in its pages place it at once in the first rank of works upon the flow of water in open channels.

## PERSONAL.

G. C. Herron was elected City Engineer of Corsicana, Texas, on the 15th.

Thos. Fuller has been appointed Chief Architect of Public Works of the Dominion, vice T. S. Scott, superannuated.

State Engineer and Surveyor Horatio Seymour, Jr., has accepted the charge of 400,000 acres of wooded land in Wisconsin from a Boston syndicate, and will move to Appleton, Wis., in January.

E. B. McClure, formerly Superintendent of the Indianapolis & St. Louis Railroad, and recently engaged in building the new line between Springfield and St. Louis, died at Litchfield, Ill., last week, after an illness of six hours.

Lewis V. B. Howell, said to be a civil engineer, aged 48 years, was found dead last Sunday in his room at No. 50 West Eleventh street, this city, where he boarded. He still had in his hand the large Colt's revolver with which he had put an end to his life. Whiskey!

Under the head of "The Danger Line in Engineering," on page 472 of last week's issue, a quotation is made from an address delivered by Capt. O. H. Ernst, Corps of Engineers, U. S. A., before the graduating class of the Engineering School of the Missouri Institute, but his name was accidentally omitted in the notice.

Harvard University will confer the honorary degree of Doctor of Laws upon Prof. Thomas Sterry Hunt, LL.D., F. R. S., a native of Connecticut, who was for more than twenty-five years chemist and mineralogist to the geological survey of Canada, and resigned that post in 1872 to accept the chair of geology in the Massachusetts Institute of Technology.

Mr. Rufus Stephenson, M. P., has received a check for $3,025 from the Dominion Department of Railways and Canals, to be handed by him to the widow of the late Mr. Eberts, of Chatham, a member of Mr. Cambie's engineering staff, who was killed while engaged on work connected with the Pacific Railway construction in British Columbia. The check represents the balance of salary due.

General Manager Scott has chosen Mr. Cecil Fleming, of the Mobile & Ohio, as General Superintendent of the Cincinnati Southern Division of the Cincinnati, New Orleans & Texas Pacific Railroad. It is believed that if the appointment gives the satisfaction which is expected, Mr. Fleming will be made General Superintendent of the entire system.

The following have been passed by the Dominion Board of Examiners at Ottawa: First examination, Dominion Topographical Surveyor, J. J. Dalton, Toronto; Dominion Land Surveyors, C. C. Duberge, Murray Bay; G. P. Roy, Ottawa; F. Vincent, Malbeia, Q.; C. A. McGraw, Aylmer; C. Bissette, Midland, Ont.; W. R. Rielly, Shawville, Ont. Preliminary examination, Alfred Parent, Rimouski. The Board goes to Winnipeg to hold examinations this week.

With regard to the Board of Works, Halifax, the following is proposed: That the powers, etc., of the Board be re-invested in the Council; that all the work in regard to cleaning and repairing streets, sewers and work in connection with the water service be under the control of the City Engineer; that all work in connection with the same, except in cases of emergency, be put up to tender and contract; that the Engineer submit a monthly report to the Mayor, detailing work done or in progress, which shall, in turn, be submitted to the Council; that the Engineer shall annually—previous to the preparation of the estimate of expenditure—submit to the City Council his estimate for the expenditure on the streets, sewers, city property, and for the removal of ashes, etc., and, if approved, the amount in each case to be placed in the estimates for the year, and voted accordingly.—*Morning Chronicle.*

General Dodge, of the Texas & Pacific Railway Company, impresses you at once as a perfect hurricane of energy and information-grasping power. His eye is bluish gray, hair brown, mustache light brown, both showing stray "silver threads," re-

minders of age and hard work. His age is about fifty, probably more, but there is no dimming of the eye nor faltering of step. He goes over the yards of the stations when the train stops and puts everybody on their mettle with his rapid questions. He and Manager Hoxie were of the builders of the Union Pacific road, and are only transferring their experience to a new field. General Dodge says they built 525 miles of road in one year on the Union Pacific road. The next feat, in the West, in this line is completing 428 miles in a year on the Texas & Pacific and New Orleans Pacific roads. General Dodge is a hard worker. Like Manager Hoxie, he is always under a stress of mental action and keeps facts and figures in his head, to be called out at any moment. His first lieutenant is D. W. Washburne, while Manager Hoxie relies on J. Herrin and G. L. Sands. As to Manager Hoxie, his powers are remarkably developed for executive, legislative and judicial work. He conducts over 3,100 miles of road, from the locating of a tank to the equipment of a division. Accurate knowledge of men is his strength. He is force itself in general appearance, carrying good humor and decision always in his face. He dispatches business with marvelous rapidity. He says he never sees an engine go by that he does not look at it with respect and admiration. He is quick and penetrative in glance, and is fifty this fall.—*Correspondence of Galveston News.*

Geo. Law, the well-known railway and steamboat millionaire, died at his residence in this city last week. He was of Irish parentage, but was born Oct. 25, 1806, in the township of Jackson, Washington County, this State. At the age of 15 a visit to Troy unsettled him for the monotony of farm life, and at 18 he left his father's home for the city. He literally commenced life at "the foot of the ladder," his first employment in Troy being in the capacity of a hod-carrier at one dollar per day. He soon advanced to the dignity and emoluments of a journeyman brick-layer, then as Superintendent of masonry on the Lehigh canal until, in 1832, he secured his first contract for the construction of a lock and aqueduct, from which realizing a profit of $2,800, he started for New York City. At 27 he married a Miss Anderson, of Philadelphia, and by the time he was 29 years old he had accumulated $28,000 from contracting on railroads and canals. In 1837 he bid for three sections of the Croton aqueduct, securing two of them, which he completed with satisfaction to the city and profit to himself. Two years later he secured the contract for the High Bridge over the Harlem River, on which he was engaged for 10 years. In constructing it Mr. Law introduced several innovations, such as pile-driving and raising water by steam. He went to Europe and examined all the famous bridges of the Old World, and combined in High Bridge all the better features of those which he examined. The work was completed in 1849, and with it ended Mr. Law's career as a contractor. He then turned his attention to railroads and banking, and subsequently to steamships and Hudson River steamboats and ferries. At the time of his death he was also largely interested in street railways in this city. For the last twelve years he has lived a life of practical retirement from business.

As might have been expected, a very large number assembled to do the last honors to the late Chief of the *Sérvice des Travaux*. The pall-bearers were M. Louis Verbrugghe, Head of the Canal Legal Service and acting *agent supérieur;* Mr. Georges Lœw, a brother-in-law of the deceased; M. Jules Lhecaudey and Chamberlaine-Bey, M. Blanchet's secretary. A handsome metal-lined coffin (requiring ten men to lift it) was placed in a handsome hearse with glass panels and nodding plumes, driven by an immense negro in a black silk hat and black gown. The horses were enveloped in rich velvet trappings, heavily trimmed with gold lace. The coffin within was covered at the head by the tricolor of France and at the foot by the Colombian flag. A great many of the canal staff attended in full dress—swallow-tail coats and white ties—carrying crushed opera hats in their hands. The majority of the mourners walked from his late residence to the cathedral of Panama uncovered. Within the ancient edifice, where the deceased was married some twenty months ago to Miss Loew, of Panama, the usual funeral service of the Church of Rome was chanted and read. Rich tropical flowers were placed on the coffin. After the service the procession was re-formed and, accompanied by many carriages, proceeded to the Foreign Cemetery, where his grave added another to the little band of canal officers who are already sleeping there. A brief sketch of M. Blanchet's life is as follows: He was born in Philippeville, Algeria, Nov. 24, 1848. He studied at the Marseilles Lyceum from 1859 to 1868, and graduated as a Bachelor of Science. He was also a graduate of the Military College of St. Cyr. He served with the Third Zouaves in 1871 in Algeria, was named corporal in October of that year and sergeant in the following April. Later he left the army, proceeded to Egypt, thence to Vienna as Conductor of Works for Messrs. Couvreux & Hersent; the latter consisted in regulating the course of the Danube. In 1875 he was named Director of Works. Later he closed the works and obtained a settlement from the Austrian Government amounting to 35,000,000 francs, after being connected with a great many vast enterprises for the same firm. He visited the Isthmus in January, 1880, with De Lesseps and his scientific corps. He returned to Paris in March of that year and commenced organizing work for the future canal. He arrived here on the 29th of January of this year, with the first expedition, as Chief of Works, representing Couvreux & Hersent, the contractors for piercing the Isthmus. He commenced work the day following and had been incessantly employed almost day and night ever since. Although advised by friends to moderate his ardor and take care, he kept on and overworked body and brain. The late M. Etienne, the friend and companion of De Lesseps, was of the same character, an incessant worker. He, too, when cautioned, said that he would return to France as soon as he got sick. His illness and death were but a matter of a few days. M. Blanchet leaves a wife, but no family. His connections in France are said to be wealthy and influential. His death, with that of Messrs. Bionne and Etienne, De Lessep's lieutenants, cannot but have a depressing influence on canal work here and act against canal interests in Paris.—*Panama Correspondence of the N. Y. World.*

## THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.*

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 469.)

### CXLIII.—MERIDEN.

Meriden, Connecticut, is in lat. 41° 33′ N., long. 72° 56′ W., in New Haven County, inland and in a rolling country. It was incorporated as a city in 1867.

Water-works were built by the city in 1869, after the plans of George H. Bishop, C. E., taking the supply from a stream of one square mile water-shed. The water is impounded in a reservoir of 75 acres area, formed by building two earth dams 26 ft. high across ravines between two high hills a mile from the city and 250 ft above it, giving a storage capacity of 300,000,000 gallons, and distributing the water by gravity.

Distribution is principally by wrought-iron and cement pipe. Since 1875 cast-iron pipe has been laid for extensions. Twenty-four miles of pipe are now in use of from 16-in. to 2-in. diameter, with 190 fire hydrants, 1,700 taps and 51 meters.

The city contributes $30 annually for each hydrant.

The population in 1880 was 18,340, and the daily consumption about 1,000,000 gallons. The supply was barely equal to the demand, and it was only by the prohibition of the use of the city water for sprinkling, and for all water-closets which were not self-closing, and by careful inspection, that a deficiency was prevented.

The cost of the works has been $350,000. The bonded debt is $325,000, bearing interest at 7 per cent. The expenditures for 1880 were, for maintenance, repairs and extensions, $5,799.39, and for interest and sinking fund, $24,350.00. The receipts were $32,561.74.

The works are managed by a committee of five members of the Common Council. H. L. Schleiter has been the Superintendent since 1878.

### CXLIV.—ZANESVILLE.

Zanesville, Ohio, in lat. 40° N., long. 82° W., on the Muskingum River, is mainly on a level plain, surrounded by hills. The town was settled about 1800 and incorporated as a city in 1855. In 1842 water-works were built after the plans of Elias Ebert, taking the supply from the river and lifting the water 185 ft. to two reservoirs on the hill, each about 100 by 200 ft. in dimension, built of brick and stone. The pumps first erected were double-acting piston pumps. In 1863 two Worthington pumps, of 2,000,000 and 3,000,000 gallons capacity, were added. The original pumps are now used only occasionally. To supply the higher portions of the city, a Knowles pump is used, pumping into a stand-pipe 75 ft. high.

Distribution is by cast-iron pipe, of which 33.81 miles is in use, from 30 in. to 2 in. in diameter, with 154 fire hydrants, 2,388 taps and 6 meters.

The population in 1880 was 18,120, and the daily consumption 1,947,000 gallons. The works have cost about $500,000. The bonded debt is $300,000. The expenditures for 1880 were for maintenance, repairs and extensions, $17,200.65, and for interest, $13,366.60. The receipts were $28,897.31. The works are managed by three trustees. W. O. Munson is the Secretary, and Elias Ebert the Superintendent.

### CXLV.—OSWEGO.

Oswego, New York, in lat. 43° 25′ N., long. 76° 33′ W., is on the northern shore of Lake Ontario, at the mouth of the Oswego River, which has a water-shed of about 3,000 sq. miles, embracing seven of the larger interior lakes of Northern New York. The city is on both sides of the river, the ground rising from the river to an elevation of about 200 ft. The river is dammed for manufacturing purposes and slack-water navigation, affording a good water-power.

Water-works were built by a private company in 1868, after the plans of William J. McAlpine, C.E., taking water from the Oswego River and pumping it by water-power into two reservoirs, one on the east side of the river, 160 ft., and the other on the west side, 190 ft. above the lake. The reservoirs are in excavation and embankment, and each is in two divisions with a sand or gravel filter in the partition wall. They contain about 7,500,000 gallons each.

Distribution is by cast-iron pipe, of which about 25 miles is in use, with 175 hydrants. The population in 1880 was 21,117. The consumption, the number of taps, the expenses and the revenue are not furnished. The city pays $20,000 per annum for water for fire purposes and the public buildings, and also $3,500 as interest on the cost of the extensions of the mains. Delos De Wolf is Presi-

* Copyright 1881.

dent, and D. Mannering, Secretary of the Company.

CXLVI.—SHERBROOKE.

Sherbrooke, in the Province of Quebec, Canada, is in lat. 45° 25′ N., long. 72° W., at the confluence of the Magog and St. Francis rivers, which afford a fine water power.

Water-works were built in 1880-1 by the Sherbrooke Gas and Water Company, a private corporation, after the plans of A. O. Granger, C. E., taking water from the Magog River, which is the outlet of Lake Memphremagog, in Vermont, and lifting it 240 ft. into a reservoir holding 3,000,000 gallons, by two Knowles pumps with 14-in. cylinders of 16-in. stroke, driven by two 54-in turbines working under 8-ft. head.

Distribution is by cast-iron pipe of which 4 miles are laid, of 8, 6 and 4-in. diameter, with 75 fire hydrants, for which the city pays $1,400 per annum. The population is 7,000. The consumption and the number of taps are not given. Gas-works were built at the same time with the water-works, the whole costing $150,000. R. N. Hall is President, and A. O. Granger Manager and Treasurer of the Company.

CXLVII.—WILKESBARRE.

Wilkesbarre, Pennsylvania, in lat. 41° 15′ N., long. 75° 52′ W., is on the east bank of the north branch of the Susquehanna River, on undulating ground. Settled in 1770, it was incorporated as a borough in 1806 and as a city in 1871. Water-works were built in 1859, by the Wilkesbarre Water Company, a private corporation, after the plans of Charles F. Ingham, C. E., taking water from Laurel Run, a mountain stream 2½ miles from the city, and 150 ft. above its general level. The stream is impounded by a stone dam 8 ft. thick at the bottom and 5 ft. at the top, and 20 ft. high, built across a ravine on a curve, with the convex side up stream, forming a reservoir of 7,000,000 gallons capacity.

A 16-in. pipe, reduced to a 10-in. further down, conveys the water to the city. The distribution is by wrought-iron and cement pipes, and some cast-iron pipe, from 8-in. to 3-in. diameter; 33 miles are laid, with 94 fire hydrants, 108 gates and 3,000 "consumers" (or probably about 600 taps). No meters are used.

The population in 1880 was 23,339. The consumption is not given. The works have cost $220,000. The capital stock of the company is $220,000 and the bonded debt $17,000. The receipts for the year ending April, 1881, were $29,415. The expenses are not given. Isaac S. Osterhout is the Secretary and Treasurer, and John Farrel, Superintendent. Water is also supplied by the Crystal Spring Water Company, of which Byron Shoemaker is Secretary, and F. D. Weir, Superintendent. No information has been furnished regarding the works of this company.

(TO BE CONTINUED.)

The receipt of statistics, etc., as follows, are acknowledged with thanks: From W. O. Munson, Secretary, statistics of Zanesville (O.) Water-works, and report of trustees for 1880-1. From H. L. Schleiter, Superintendent, statistics and water rates of Meriden (Conn.) Water-works, and report for 1880. From D. Mannering, Secretary and Treasurer, partial statistics, water rates and contract with city of the Oswego (N. Y.) Water-works Company. From A. O. Granger, description of Sherbrooke (Canada) Water-works.

The Goshen Foundry and Gas Machine Co., of Goshen, N. Y., are putting up gas-works in Delhi, Herkimer, Oneonta and Waterville, N. Y. Those at Ellenville, N. Y., erected by the same company, are completed and furnish light for the whole village; the others are being rapidly pushed to completion. The same company have also put up works for making their gas at Elizabethport for the Singer Sewing Machine Co. to light their factory, and the village; which works have lately been enlarged to meet the demand for increased light.

## SOURCES OF ENERGY IN NATURE.

[From the Journal of the Franklin Institute.]

There are several papers of interest in this number. Discussions on Steel Rails, by the American Institute of Mining Engineers, and the necessity of Clear Mechanical Conception, by Mr. D. Marks, Professor of Dynamical Engineering, University of Pennsylvania. As illustrating the importance of this subject and how uncertain the sound emanating from great names may be, he states as follows:

"That the writer may not appear to have "set up a man of straw" for the pleasure of demolishing him, he will instance a few cases occurring in the works of the abler writers upon mechanics, passing over without notice the too apparent evasions and misconceptions of a host of writers of so-called "elementary mechanics.

"Prof. Wm. Whewell, who is probably the clearest writer in the English language upon mechanics, constantly uses the terms force and pressure interchangeably. Pressure refers rather to force distributed over a considerable surface, as in the case of water, the atmosphere, etc.

"Prof. Rankin calls the moment of inertia of a revolving body the weight multiplied by the square of the radius of gyration; this expression is not the moment of inertia, but only *the measure of the moment of inertia.*

"Prof. Tyndall defines heat as "a mode of motion;" it is really a form of work. Possibly this apparent error is a wilful misstatement, made with a design to convey to his readers an approximate idea of what he did not believe them capable of conceiving fully. It certainly is either an error or a concession to ignorance, which has done much harm."

From the same periodical, we quote from a paper by Sir W. Thomson, on the Sources of Energy in Nature, the following estimate of the loss of energy by concession into heat in transmission by copper conductors:

"Taking Niagara as example, and with the idea of bringing its energy usefully to Montreal, Boston, New York and Philadelphia, I calculated the formula for a distance of 300 miles (which is greater than the distance of any of these four cities from Niagara, and is the radius of a circle covering a large and very important part of the United States and British North America). I found almost to my surprise that, even with so great a distance to be provided for, the conditions are thoroughly practicable with good economy, all aspects of the case carefully considered. The formula itself will be the subject of a technical communication to Section A in the course of the meeting on which we are now entering. I therefore, at present, restrict myself to a slight statement of results:

"1. Apply dynamos driven by Niagara to produce a difference of potential of 80,000 volts between a good earth-connection and the near end of a solid copper wire of half an inch (1·27 centimeters) diameter and 300 statute miles (483 kilometers) length.

"2. Let resistance by driven dynamos doing work, or by electric lights, or—as I can now say—by a Faure battery taking in a charge, be applied to keep the remote end at a potential differing by 64,000 volts from a good earth-plate there.

"3. The result will be a current of 240 webers through the wire taking energy from the Niagara end at the rate of 26,250 horse-power, losing 5,250 (or 20 per cent.) of this by the generation and dissipation of heat through the conductor, and 21,000 horse-power (or 80 per cent. of the whole) on the recipients at the far end.

"4. The elevation of temperatare above the surrounding atmosphere, to allow the heat generated in it to escape by radiation and be carried away by convection is only about 20° Centigrade; the wire being hung freely exposed to air like an ordinary telegraph wire supported on posts.

"6. The cost of the copper wire, reckoned at 8d. per pound is £37,000; the interest on which at 5 per cent. is £1,900 a year. If 5,250 horse-power at the Niagara end costs more than £1,900 a year, it would be better economy to put more copper into the conductor; if less, less.

I shall only say, in conclusion, that one great difficulty in the way of economizing the electrical transmitting power to great distances (or even to moderate distances of a few kilometers) is now overcome by Faure's splendid invention. High potential—as Siemens, I believe, first pointed out—is the essential for good dynamical economy in the electric transmission of power. But what are we to do with 80,000 volts when we have them at the civilized end of the wire? Imagine a domestic servant going to dust an electric lamp with 80,000 volts on one of its metals! Nothing above 200 volts ought on any account ever to be admitted into a house or ship, or other place where safeguards against accident cannot be made absolutely and forever trustworthy against all possibility of accident. In an electric workshop, 80,000 volts is no more dangerous than a circular saw. Till I learned Faure's invention I could but think of step-down dynamos, at a main receiving station, to take energy direct from the electric main with its 80,000 volts, and supply it by secondary 200-volt dynamos or 100-volt dynamos, through proper distributing wires, to the houses and factories and shops where it is to be used for electric lighting and sewing machines and lathes and lifts, or whatever other mechanism wants driving power. Now the thing is to be done much more economically, I hope, and certainly with much greater simplicity and regularity, by keeping a Faure battery of 40,000 cells always being charged direct from the electric main, and applying a methodical system of removing sets of 50 and placing them on the town-supply circuits, while other sets of 50 are being regularly introduced into the great battery that is being charged, so as to keep its number always within 50 of the proper number, which would be about 40,000 if the potential at the emitting end of the main is 80,000 volts.

From the proceedings, as to the conduit to be used on Market street, Philadelphia, by the National Underground Electric Company. The necessary trench to be dug is about 4 ft. deep by 18 in. wide and the bottom and sides to be used are lined with hydraulic cement. The tubes are made of tinned iron about 2 in. diameter and are in convenient lengths, regulated by the size of the sheets of tin soldered together. Bands of tarred paper are wrapped around the tubes to prevent them from touching and to allow the spaces between them to be filled with the insulating material, which is a composition of asphaltum and slag. The tubes are twenty in number—laid in four rows of five each, one above the other—and each tube will hold a number of insulated wires. The work is completed with concrete on the top, filling in of earth, paving, etc. Manholes are constructed at each square for any necessary repairs.

## CORRESPONDENCE.

### SHARPEST N. G. CURVE ALLOWED.

PINEY FALLS, Rhea Co., Tenn., Nov. 21, 1881.

EDITOR ENGINEERING NEWS:

Will you have the kindness to inform me what is the sharpest curve used for general traffic on a three-foot gauge railroad, or what would be the highest degree safe to use in putting in a "Y?"

I desire to put one in where I am cramped for room, and have no experience on narrow-gauge roads.

Please answer in your journal and greatly oblige. Yours very truly, R. H. L. JEWETT.

### AMERICAN RAILWAY BUILDING.

LIVINGSTON STATION, Ky., Nov. 16, 1881.

EDITOR ENGINEERING NEWS:

In your article on "American Railway Building," in the issue of Nov. 12, you accredit the Louisville & Nashville with 170 miles of road under construction (Pensacola & Atlantic), which is too little by far. Outside of the Evansville & Henderson Gap, and the large bridge over the Ohio at the latter place, which are to be pushed, the above company is now building the Knoxville Extension of the Lebanon Branch from this place to the Kentucky and Tennessee State line, where it will be met by the extension of the Knoxville & Ohio Railroad, a branch of the East Tennessee, Virginia & Georgia. The Kentucky end is 61 miles long, includes 4 tunnels and 25 bridges; the Tennessee end will be 27 miles long and have 5 tunnels; all of the work, with the exception of a few sections, is heavy, going through the Wildcat hills and spurs of the Cumberland Mountains.

The work on grade has been prosecuted since last February on this end, and now it is ready for track to Wildcat Tunnel, five miles from here.

Rockcastle River is crossed by two spans of 94 and 184 ft. iron bridging, built in first-class style, by the Louisville Bridge and Iron Company.

Track will be laid to London, 18 miles from here, by coming spring, after which the advance is expected to be rapid, as from 1,500 to 2,000 men are employed on the Kentucky end alone.

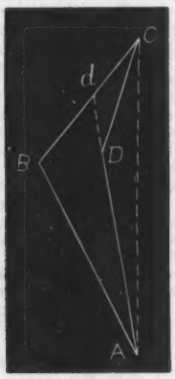
This line will secure to Louisville a direct route to the southeastern sea-board, and is expected to be of considerable benefit to the city, as well as to the great company that is building it. K.

## TRIANGULATION.

TOPEKA, Kan., Nov. 13, 1881.

EDITOR ENGINEERING NEWS:

Will some one furnish the simplest solution to the following problem: Given angles at *A*, *D* and




*C*, and distances *AD* and *DC* of the irregular figure *ABCD*? Required distances *AB* and *BC*.

Yours truly, K. A.

[*First Solution.* Produce *AD* to *d*. Then in the triangle *DdC* we have the three angles and the side *DC* to find the sides *Dd* and *dC*. In the triangle *ABd* we have the three angles and side *Ad* to find sides *AB* and *Bd*. *Second.* Draw the line *AC*. Then in the triangle *ADC* we have the two sides *AD* and *DC* and included angle *ADC* to find the other parts. Then in the triangle *ABC* we have the two angles *BCA* and *CAB* and included side *AC* to find sides *AB* and *BC*.

From the above our correspondent can easily determine the simpler method.]

## PUBLIC SURVEYS.

Washington, Nov. 10.—The whole question of the system under which the surveys of the public domain have been hitherto conducted will come before Congress at the ensuing session. The history of legislation upon the mode of surveys by special deposit, and the manner in which it has been made to subserve purposes of glaring fraud, is given at length in the forthcoming report of Judge McFarland, commissioner at the general land office. His predecessor, Gen. James A. Williamson, in a recent interview upon the subject, stated that during his administration of the office complaints of fraud had been made to him. The most tangible instance was one where it was alleged that a large tract of land had been surveyed as desert land, and was afterward claimed to be swamp land, which is the most valuable class of land within the boundaries of the public domain. He investigated the matter thoroughly, and found that the charge was utterly without foundation. He issued strenuous instructions, however, with the view of preventing any possibility of fraud in the future, and even threatened to suspend the operation of the law if it was found to be necessary. The modus operandi of unlawful money-making under surveys by the special-deposit system is about as follows: Deputy surveyors have induced speculators to advance large sums of money, which are paid in in the names of imaginary settlers. The deputy surveyor obtains his contract and runs his exterior lines over some uninhabited country or desert waste, say in Nevada. He writes up imaginary field notes. His plats and field notes are transmitted to Washington, and he obtains his money. The money to pay for the survey is deposited by his partners in guilt. Where does their profit come from? The answer is simple. The triplicate certificates were assignable even before the contract was completed, and had been sold at a small discount to bona-fide settlers, say in Oregon, who paid them to the United States for lands fairly purchased and honestly settled by them. The profit and loss account would then stand: For every $100 actual cost of survey as performed, $20; on triplicate certificate sold to honest settlers, $10, leaving a balance of $70 to be divided between the deputy surveyor and his confederates—quite a percentage in favor of the bank. This is the principal system of fraud practiced under the obnoxious laws. The amounts paid for surveys on uninhabitable land are a dead loss to the government, and also those paid on contracts imperfectly completed on land available for settlement, as such work will all have to be gone over again. Commissioner McFarland in his forthcoming report says:

Under sections 2,401, 2,402 and 2,403, Revised Statutes, it is provided that "when settlers in any township, not mineral or reserved, desire a survey of the same under authority of the surveyor general, they shall be entitled thereto upon filing a written application therefor and depositing a sum sufficient to pay for the survey and all expenses incident thereto; that said sums so deposited shall be placed to the credit of the proper appropriation for the surveying service, and that the amount so deposited by any such settlers may go in part payment for their lands situated in the township, the surveying of which is paid out of such deposits." By act of March 3, 1879, amendatory of section 2,403, Revised Statutes, the certificates issued for such deposits were made assignable by indorsement, and receivable in payment for pre-emption and homestead claims. Since the passage of the act of 1879 the deposits of surveys have increased to an unprecedented extent, and numerous representations, which are believed to be true, have been made to this office that lands of no present practical value, and on which there are no settlers, have been largely surveyed; that applications for surveys are fraudulently prepared by or through the instigation and management of deputy surveyors, who, for the purpose of securing the contract for making the survey, either themselves or through friends advance the money for the deposit, thereafter sell and assign the certificates, and thus reimburse themselves and secure their profit from the surveying contracts. The appropriation for surveys for the last fiscal year was $300,000. The amount of deposits for the same period, and which was placed to the credit of the said appropriation, was $1,804,166.47, and the amount of certificates surrendered in payment of pre-emption and homestead claims for the same time was $1,346,109.26. It is believed that the practical result of the act of March 3, 1879, has been to cause the survey of vast areas of lands of no present and perhaps no prospective value, and the surrender of title to valuable lands in payment for such surveys. The original act, in its purpose and intent, in the commissioner's opinion, is well adapted to the wants of actual settlers who desire to obtain title to their settlements without being subject to the enforced postponement incident to surveys under the present system; but the temptations to irregularity and fraud are too great and the means of evading the law too easy to justify a reasonable expectation that the law can be administered to the public interest. The repeal of said act of March 3, 1879, would still leave prior provisions, as found in the Revised Statutes, sections 2,401, 2,402 and 2,403, available for actual settlers, and these provisions are as liberal as, in my judgment, can safely be extended for their relief; for, in addition to the irregularities hereinbefore named, it is to be considered that it is very difficult to examine and prove the proper execution of the surveys covering so large areas, and very probable that those who would fraudulently procure a surveying contract would fraudulently execute it. I therefore recommend the repeal of said act of March 3, 1879, and an increased appropriation for surveys.

The commissioner urges also an entirely new departure in the whole method of conducting the public surveys. The very unsatisfactory manner in which examinations of surveys in the field are made by deputy surveyors, under the direction of the several surveyors general, and the general slighting of this important work, need, in the opinion of the commissioner, a radical and wholesome change. It is an absurdity to suppose that truthful and honest returns of examinations in every particular will be made by deputy surveyors, upon whom surveyors general are more than ordinarily dependent for examiners, when it is considered that the examining deputy will at the same time, if not already under obligations, have his own work examined by the very deputy whose work he has, if honest, condemned. The temptation of overlooking defects, either in the survey of lines or the marking of the same, has proven too great to be resisted by them. It is safe to say that not 1 per cent. of the number of examinations is satisfactory to the general land office in the results obtained. It is therefore earnestly recommended that the amount set apart for examinations of surveys, either by appropriation or construction of the law by the treasury department as applicable to the same, be disbursed directly by the general land office, through agents appointed for the purpose, who shall be removable only for cause and who shall make all examinations required, either at the suggestion of the surveyor general or at the instance of the office commissioner, to report directly to and be responsible to the general land office alone, and be in every way independent of the surveyor general, and to receive such fair compensation as may be determined upon by the secretary of the interior. It is firmly believed that only by making them independent of the surveyors general and responsible to the general land office alone, honest and faithful returns of examinations can be secured, and that it is the best as well as the cheapest method pecuniarily, and will have a most salutary effect upon the entire surveying service, and is the only means by which to purge the service of worthless and contaminating individuals.

## ENGINEERS' CLUB OF PHILADELPHIA.

RECORD OF MEETING, NOV. 19, 1881.

Past President, Frederic Graff, occupied the chair, and 23 members and 2 visitors were present.

Mr. S. Castle Gant presented an illustrated description of his proposed underground railroad connections, for freight and passengers, in Philadelphia. The general scheme contemplates the construction of the following system of lines. Descending, with four tracks, on the Philadelphia & Reading Railroad from Thompson street to the beginning of the tunnel proper at Spring Garden street, it would follow the line of the latter to Broad street, where it would meet a two-track line from the Delaware front, via Ninth and Green streets depot (where connection would be made by hydraulic lifts or inclined plane), or, should that depot be abandoned, by a four-track tunnel up Broad street to the present Philadelphia & Reading and Pennsylvania Railroad crossings. From Broad and Spring Garden streets the united lines would continue, via the present and proposed Philadelphia & Reading depots, by a diagonal avenue to Twelfth and Market streets. At this point it would be joined by a two-track tunnel from West Philadelphia yard of Pennsylvania Railroad by tunnel under Schuykill River, or by hydraulic lifts or inclined plane from present elevated road, leading down Filbert street and around the City Hall, and also by a two-track tunnel from the Baltimore depot via Broad street.

These concentrated lines would then pass down Market street, via central depots on both sides of street between Fourth and Fifth streets, to the Delaware River. Here it is proposed to build a floating dock of 142 acres, from Market street to Washington avenue, by inclosing with embankments the space between the present shore and islands, bounded on the north by a tidal dock of 38 acres; to extend the wharf line in conformity therewith to the Richmond coal wharves and to build a dam across the back channel of Treaty Island. High and low level lines would be constructed along this new river front, and by means of the former the largest vessels could be loaded without elevators. The purity of the dock water could be maintained by intercepting sewerage.

With regard to cost, Mr. Gant estimates that the four-track tunnel from Pennsylvania avenue, via Spring Garden, Broad, the diagonal avenue and Market street to the Delaware River, and the two-track tunnel from Willow street and Delaware avenue to Broad and Spring Garden streets, would cost $1,750,000, exclusive of purchase of property, the value of which he considers would be enhanced by the opening of the proposed avenue.

He suggests this scheme as only the beginning, in Philadelphia, of underground railroads, in so many particulars, for both passenger and freight traffic, to be preferred to surface or elevated roads.

The remainder of the evening was occupied in discussing several proposed new quarters for the club. After taking a recess to visit three of those thought most desirable, the Board of Directors recommended to lease the rooms at No. 1,528 Chestnut street, opposite the present rooms.

## A NEW METHOD OF KEEPING MECHANICAL DRAWINGS.

[A Paper by Chas. T. Porter, read before the American Society of Mechanical Engineers.]

The system of keeping drawings now in use at the works of the Southwark Foundry and Machine Company, in Philadelphia, has been found so satisfactory in its operation that it seems worthy of being communicated to the profession.

The method in common use, and which may be called the natural method, is to devote a separate drawer to the drawings of each machine, or of each group or class of machines. The fundamental idea of this system, and its only one, is keeping together all drawings relating to the same subject matter.

Every draughtsman is acquainted with its practical working. It is necessary to make the drawing of a machine and of its separate parts on sheets of different sizes. The drawer in which all these are kept must be large enough to accommodate the largest sheets. The smaller ones cannot be located in the drawer, and as these find their way to one side or to the back, and several of the smallest lie side by side in one course, any arrangement of the sheets in the drawer is out of the question.

The operation of finding a drawing consists in turning the contents of the drawer all up until it is discovered. In this way the smaller sheets get out of sight or doubled up, and the larger ones are torn. No amount of care can prevent confusion.

Various plans have been adopted in different establishments intended to remedy this state of things, but it is believed that none has been hit upon so convenient, in all respects, as the one now to be presented.

The idea of keeping together drawings relating to the same machine, or of classifying them according to subjects in any way, is entirely abandoned, and in place of these is substituted the plan of keeping together all drawings that are made on sheets of the same size, without regard to the subject of them.

Nine sizes of sheets were settled upon as sufficient to meet our requirements, and on a sheet that will trim to one of these sizes, every drawing must be made. They are distinguished by the first nine letters of the alphabet. Size A is the antiquarian sheet trimmed, and the smaller sizes will cut from this sheet, without waste, as follows:

A, 51 × 30 in.; B, 37 × 30 in.; C, 25 × 30 in.; D, 17 × 30 in.; E, 12½ × 30 in.; F, 8½ × 30 in.; G, 17 × 15 in.; H, 8½ × 15 in.; I, 14 × 25 in.

The drawers for the different sizes are made 1 in. longer and wider than the sheets they are to contain, and are lettered as above. Those of the same size, after the first one, are distinguished by a numeral prefixed to the letter. The back part of each drawer is covered for a width of from six to ten inches, to prevent drawings, and especially tracings, from slipping over at the back.

The introduction of the blue printing process has quite revolutionized the drawing office, so far at least as we are concerned. Our drawings are studies, left in pencil. When we can find nothing more to alter, tracings are made on cloth. These become our originals, and are kept in a fire-proof vault. This system is found admirably adapted to the plan of making a separate drawing for each piece. The whole combined drawing is not generally traced, but the separate pieces are picked out from it. All our woking copies are blue prints.

Each drawer contains 50 tracings. They are 2½ in. deep, which is enough to hold several times as many, but this number is quite all that it is convenient to keep together. We would recommend for these shallower drawers.

Each drawing is marked in stencil in the lower right hand corner, and also with inverted plates in the upper left-hand corner, with the letter and number of the drawer, and its own number in the drawer, as, for example, 3 *F* — 31; so that whichever way the sheet is put in the drawer, this appears at the front right-hand corner. The drawings in each drawer are numbered separately, 50 being thus the highest number used.

For reference we depend on our indices. Each tracing when completed is entered under its letter in the numerical index, and is given the next consecutive number, and laid in its place.

From this index the title and the number are copied into other indices, under as many different headings as possible.

Thus all the drawings of any engine or tool, or machine whatever, become assembled by their titles under the heading of such particular engine or tool or machine. So also the drawings of any particular part, of all sizes and styles, become assembled by their titles under the name of such piece. However numerous the drawings, and however great the variety of their subjects, the location of any one is, by this means, found as readily as a word in a dictionary. The stencil marks copy, of course, on the blue prints, and these, when not in use, are kept in the same manner as the tracings, except that only 25 are placed in one drawer.

We employ printed classified lists of the separate pieces constituting every steam engine, the manufacture of which is the sole business of these works, and on these, against the name of every piece, is given the drawer and number of the drawing on which it is represented. The office copies of these lists afford an additional mode of reference, and a very convenient one, used in practice almost exclusively. The foreman sends for the prints by the stencil marks, and these are thus got directly without reference to any index. They are charged in the same way, and reference to the numerical index gives the title of any missing print.

We find the different sizes to be used quite unequal. The method of making a separate tracing of each piece, which we carry to a great extent, causes the smaller sizes to multiply quite rapidly. We are marking our patterns with the stencil of the drawing of the same piece; and also, gauges, templets and jigs.

It is found best to permit the sheets to be put away by one person only, who also writes up the indices, which are kept in the fire-proof.

We were ourselves surprised at the saving of room which this system has effected. Probably less than one-fourth the space is occupied that the same drawings would require if classified according to subjects.

The system is completely elastic. Work of the most diverse character might be undertaken every day, and the drawings of each article, whether few or many, would find places ready to receive them.

## RAPID TRANSIT IN NEW YORK.

But few persons who have not been in New York since the construction of the elevated roads, and witnessed their equipments and operations, can have any adequate idea of the extent of them, and of the people, machinery and appurtenances required in working them. A recent inventory discloses the fact that there are 32 miles of roadway, 161 stations, 203 engines and 612 cars, while 3,480 trains a day are run. There are 3,274 men employed on these roads, 309 of whom are engineers, 258 ticket agents, 231 conductors, 308 firemen, 395 guards or brakemen, 347 gatemen, 4 road inspectors, 106 porters, 33 carpenters, 27 painters, 69 car inspectors, 140 car cleaners, 40 lamp-men, and 470 blacksmiths, boiler-makers and other mechanics employed on the structure and in the shops. Most of the ticket agents are telegraph operators, but there are 13 other operators employed. There are four double-track lines in operation. The aggregate daily receipts vary from $14,000 to $18,000; and as many as 274,023 passengers have been carried in one day. Engineers are paid from $3 to $3.50 per day; ticket agents, $1.75 to $2.25; conductors, $1.90 to $2.50; firemen, $1.90 to $2.50; guards, or brakemen, $1.50 to $1.65; and gatemen, $1.20 to $1.50. The above items do not include machinists and other employés in the workshops, or the general officers, clerks, etc.

# GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

## GAS AND WATER.

The National Meter Company's Crown Water Meter has been adopted by the Department of Public Works of New York City, its thorough efficiency and fitness having been satisfactorily demonstrated by rigid tests of accuracy and durability.

Arrangements are perfected to build water-works in Leavenworth, Kan., at a cost of $300,000. A local company will have control.

The people of Paris, Ont., are agitating for a system of water-supply. The insurance men of the town offer a reduction of 20 per cent. in case an efficient system is secured.

The large iron works of John F. Starr, at Camden, N. J., have been given into the hands of a committee of creditors, who will operate them until various pending contracts are finished, when some permanent arrangements will be made.

The directors of the Mount Vernon (N. Y.) Water Company, organized last week to sink artesian wells, have elected Charles H. Willson, president; Oliver Dyer, vice-president; Joseph S. Wood, secretary, and Gerd Martens, treasurer.

The mammoth machinery to be used at the lower falls of the Genesee River to condense the air that is to be used for the motive power of the Hydraulic Motor Company, in Rochester, is about ready to begin work. The compressor weighs 30,000 pounds and is of immense power. The actual weight of water that will flow into the pipe each minute is 600 tons. This falls a distance of over 50 feet, and the power obtained is almost incalculable.

Jamestown, N. Y., has contracted with the Jamestown Water-works Company for public water supply through 100 hydrants at an average rental of $60 each. The entire works will be built by the Holly Manufacturing Company, of Lockport, New York, on the Holly plan of direct pumping; are to be completed by July 15, 1882, and of capacity to furnish two millions of gallons of water per day, and to throw six powerful fire-streams directly from the hydrants. The water-pipes will be furnished by the Cincinnati & Newport Iron & Pipe Company, of Cincinnati, Ohio.

A special meeting of the Board of Water-works of Newport, Ky., was held in the City Clerk's office on the 19th, for the purpose of receiving proposals and awarding a contract for the construction of a pumping engine with the capacity of 3,000,000 gallons every twenty-four hours, or two engines of 2,000,000 gallons capacity each per day, to work independent of each other. A communication from the Cope & Maxwell Manufacturing Company, Hamilton, O., through their President, J. C. Morris, asking further time to complete their calculations previous to making a bid on the work, was received and the desire of the petitioners granted for two weeks.

J. D. Cook, Chief Engineer of the Springfield, (O.) Water-works, has accepted the new iron bridge over Buck Creek; cost $3,138.75. The work on the stand-pipe foundation is now making good progress. Only three courses of stone remain to be put in, when the metallic structure will begin to rise. The Cope & Maxwell Manufacturing Company, contractors for the pumping engines, say that both engines can be put into position, ready for work, within six weeks. The total amount of pipe laid to date is fifteen and one-third miles—over half the city. The total expenditure to date on water-works is $256,829.44.

The Howe Water Meter Company, of Portsmouth, N. H., was incorporated under the laws of that State last September, and is now manufacturing meters under patents granted to Mr. C. H. Bacon, of Boston. In this meter two cast-iron cylinders are placed in the shape of a V, joined at the bottom and arranged to oscillate on their common base as the contained quicksilver causes the center of gravity of the two cylinders to change. The oscillation opens to one cylinder the ports of the supply pipe, and at the same time shuts those to the other cylinder; when the cylinder oscillates back the same thing is accomplished with the other cylinder. The water from the supply pipe rushes in at the port which happens to be open, forces the quicksilver from that cylinder into the other, when the center of gravity changes and the two cylinders again oscillate and the ports are inversely opened and shut. The cylinders oscillate about twenty degrees, and each oscillation registers on a suitable dial the amount of water which the two cylinders contain. The New York office of the company is in the *Post* building, 16, 18 Exchange Place.

## BRIDGES.

The Colorado Bridge Co. was incorporated at Austin, Texas, last week.

Chicago bridges cost $1,000,000, and $150,000 a year to maintain them.

The Iron Mountain railroad bridge across Salms river, near Benton, Ark., burned on the 18th.

A stone arch bridge over the Little Miami Railroad on Pleasant street, Columbus, is ordered advertised for proposals by the City Council.

A span of the Cairo & Vincennes railroad bridge at St. Francisville, Ill., was washed away on the 18th, and all travel on the road was checked.

Early on the morning of the 19th the high waters of the Mississinewa River carried away the middle span of the bridge work of the Ft. Wayne, Muncie & Cincinnati Railroad.

The Board of Chosen Freeholders of Monmouth County, N. J., have contracted for a $30,000 iron bridge over Green's Pond, on Ocean avenue, between West End and Elberon.

On the afternoon of the 18th, the trestle-work of a new iron bridge to span the Sangamon River at the Moffit Ford was washed away, and the river is now out of its banks. Eighty thousand feet of lumber disappeared.

At Wilmington, Ill., on the 19th, two freight trains, laden with coal and merchandise, ran together on the bridge over the Kankakee River, when a thirty-foot span gave way, precipitating an engine and twelve cars into the river, where they now lie in a badly demoralized state.

An examination of the Seekonk River bottom has been made by the city engineer of Providence, R. I., acting under instruction of a committee of the legislature, for the purpose of determining the best kind, and also the probable cost, of piers and abutments for the proposed new bridge near India Point. The proposed location of the new bridge is in a direct line from near the corner of Gano and Front streets, in this city, to the junction of Warren avenue and Taunton turnpike, in East Providence. The water at the bridge location varies from 6 feet to 308 feet. The bottom was

found to be very variable, consisting of, first, a thick bed of mud and oyster shells, then a bed of sand and gravel of varying thickness, underlying which at some of the wells was found a bed of quicksand of considerable thickness. Slate rock was struck at two of the wells at depths of 96 4 and 105.9 feet below mean high water. Part of the time the work was prosecuted day and night, and the skill of the contractor, Mr. D. L Baker, in overcoming and avoiding difficulties aided much in the prompt completion of the work. The work was done under the personal supervision of W. D. Bullock, assistant engineer in the city engineer's office. It is expected that the plans and estimate of cost will be completed in time for the committee to present when the legislature meets in January.

## RAILROADS.

The Chicago, Milwaukee & St. Paul Railroad has bought John I. Blair's interest in the Chicago & Pacific road for $1,800,000.

The construction of the Missouri division of the Northern Pacific cost the company $2,000,000. This division extends from Bismarck to Glendive, on the Yellowstone, a distance of 221 miles. There are 380 bridges on the division,

The New York elevated railways have been consolidated under one management, the Manhattan Company, Jay Gould President, being now the absorber of the other two. Jay Gould, Cyrus W. Field and Russell Sage were the triumvirate that made the agreement.

It is stated that the Construction Company of the Texas Pacific road is building the line at an expense of about $10,000 per mile. It receives in compensation from the Texas Pacific Company about $20,000 in Texas Pacific stock, which is worth in the market about $12,000, and $20,000 per mile in mortgage bonds. From this it is clear that people who buy Texas Pacific stock give a profit to the promoters of the scheme and their associates of about $23,000 per mile.—*Graphic.*

Arrangements are completed for the organization of the Cincinnati, Selma & Mobile Railroad. This company will operate 72 miles of road leading from Akron, on the Alabama Great Southern Railroad, to Selma. A long contract for the use of the road from Selma to Montgomery having been made with the Louisville & Nashville Railroad Company, the gap of 17 miles between Akron and Greensburg will be put under contract at once and completed by the middle of January.

To provide dinner for passengers on the new fast Chicago train, a man will daily accompany it from New York to take down numbers and letters indicating the kind and number of dishes of different sorts which the passengers desire. These are inclosed in an envelope and thrown off at Poughkeepsie, whence they are telegraphed to the Albany restaurant. At Albany, men enter the train with baskets containing the dinner, and serve it, remaining on the train till Yosts is reached, where water is taken. A stop of 20 minutes is made at Buffalo for supper.

British India has, for a few years past, made some show as a seller of wheat. Her railway system has been pushed forward with great energy, first by private corporations with government guarantee, and latterly by the government itself. Over eight thousand miles have been constructed up to this time, and the lines are so judiciously disposed as to convey conveniently a large proportion of the supplies of the peninsula to the three great markets of Bombay, Calcutta and Madras, and thence by the Suez Canal to England. This ability to shift food supplies from one point to another by rail has given the Indian government the means of managing with reasonable address the famines so constantly occurring in that country.

WILDCAT PROJECTS.—The great number of new railroads that have sprung into existence—though mainly on paper, it must be admitted—of late months have drawn the attention of the more conservative class of capitalists both here and in the East to the responsibility of some of those mushroom corporations. A capitalist, in discussing the question, gives it as his opinion that we are on the eve of a collapse in railroad building, and that it is even probable that this collapse will come before spring. "I simply apprehend," says this gentleman, who is noted for his close observance of the financial world, "that there is going to be a sinking down and disappearing of wildcat railroad enterprises. The people are going to find out that nearly all the new railroads are built on dishonest principles. Take the new railroad from Buffalo to Chicago, of which about five hundred miles are under contract. The cost of the entire work will not be $15,000,000, yet they have issued three mortgages of $15,000,000 apiece, and put stock on the top of that and mortgaged the stations, terminal facilities, etc., and their bonds in some cases sell above par. Consequently they are putting millions in their pockets and giving the stockholders a road so saddled with debt that it will inevitably pay no dividends and probably go into bankruptcy. There is scarcely one railroad in this country which is not being bonded and stocked for three times its cost, the schemers or 'promoters' putting in their pockets in advance two-thirds of the money received for the sale of the securities, and giving the innocent public the other third. The time is not far off when such schemes will be punished with the penitentiary. A new collapse is required to compel honesty by law in such things. After the lessons we had in 1873 of construction companies and land grabs, etc., it might have been thought that we could build a few railroads eight years later on principles of common honesty. But if you look through these new railroads you will find many of the same old hands who were in the swindles of ten years ago. They are now putting two or three railroads into Vanderbilt's belt. No wonder he is exasperated and begins a railroad war, because he knows just the amount of revenue one road can draw from that section. He is barely earning dividends now. The railroad war, however, arose from natural causes."—*Chicago Times.*

## NEW PROJECTS.

The Denver & New Orleans R. R. route runs by Pueblo.

Beaumont, Texas, County Court is figuring on the cost of a new jail.

The new reformatory for women, toward which the State appropriated $100,000, is to be located at Hudson.

Sheboygan, Wis., improvements this season amount to about $200,000. Harbor, $12,000; water-works, $25,000; and dwellings about $160,000.

A railroad "boom" is spreading all over Arkansas, and if all the projected roads are built, the State will be checkered with steel rails from one end to the other.

Articles of incorporation were filed in Springfield, Ill., Nov. 18, by the Streator & Bloomington Railroad Company, with a capital stock of $1,200,000.

The track of the Michigan Southern is to be doubled between Toledo and Chicago. A maximum grade of twenty feet to the mile has been established.

Engineers have been engaged to survey the new line of the Burlington & Ohio River road from Burlington, Ia., through Illinois to St. Louis, with a branch from Staunton, Ill., to some point on the Ohio River.

The survey of the Neillsville & Northwestern Railroad, which is being projected in the interests of the Chicago, St. Paul, Minneapolis & Omaha, is now completed to Marshfield, and it is stated that the work of grading will be commenced early next spring.

License to organize was issued by the Secretary of State of Illinois to the Columbia Wrecking and Floating Company of Chicago. The incorporators are D. B. Baker, H. M. Smith, J. W. Powers and H. E. Burbank. The capital of the new company is to be $100,000.

It is said that the contractors for the Greece's Point Works, Ontario, have thrown up their contract, and that the government has consented to take it off their hands. The Cobourg harbor contract has also, it is said, been taken off the hands of the contractors, and Mr. Kilgannan, C. E., sent to take charge.

Another Red River company has filed notices of incorporation with the Secretary of State at St. Paul, with the object of building a road from some point on the Manitoba road between St. Cloud and Alexandria to Red Lake River, then to the boundary line, 50 miles east of Red River. The capital is $3,000,000.

The Chamber of Deputies have passed a bill authorizing the construction of the Huesca & Canfranc Railway, with a subvention of 60,000 pesetas per kilometer. The cost of boring a tunnel through the Pyrenees is estimated at 15,000,000 pesetas ($2,600,000), which will be borne equally by France and Spain.

The Chicago & Grand Trunk Railroad has surveyed two lines from Pontiac to Jackson, with the idea of completing the Michigan Air Line, either by the original survey via Pinckney and South Lyons, or by way of Pinckney and Stockbridge. Which route will be taken has not yet been determined upon, but the road will be surely built the coming spring.

A contract has been signed with the Canon River Improvement Company to build a new line of road from Red Wing, via Cannon Falls and Faribault and Waterville, to Mankato, Minn. This company was originally organized to construct slack-water navigation on the Cannon River, and thence by way of Lake Elysian to the Minnesota River near Mankato. It received a grant of 300,000 acres of swamp land for this purpose by act of March 2, 1865, but a few years ago the company was authorized to apply the grant to the construction of a railroad on the general route of the abandoned slack-water navigation project. It is further stated that it is designed to make the new road a branch of the Minneapolis & St. Louis, with which it will connect at Waterville.

There have been taken out recently two railroad charters in Arkansas, one under the name of the Mississippi, Arkansas & Texas Road, extending from opposite Greenville, Miss., to Texarkana, to meet the future necessities of the Georgia Pacific Railway. The other, called the Greenville & Bowie Railroad, to extend from the same point on the river to Tripp's Station, 18 miles, on the Little Rock & Texas Railroad. This latter is to give connection between Greenville and St. Louis. Capt. T. S. Anderson, of Greenville, has been employed to make surveys and furnish necessary specifications for the letting of the contract for its construction. This short line will be built only in connection with the Georgia-Pacific Railway Company, or Little Rock & Mississippi Railroad, and the New Orleans, St. Louis & Chicago Railroad, connecting those two roads at Greenville, Miss.

For an act to incorporate the Portage, Washbourne & Northwestern Railway Company to empower them to build and operate a line of railway from the present terminus of their railway northwesterly to the Forks of the Saskatchewan, and thence to the Peace River; and also a branch south of the Saskatchewan to the mouth of that river, and a branch in a southerly direction to the main line of the Canada Pacific Railway. The company have completed grading the line from Portage to Gladstone, 37 miles, and have on the spot rails for 19 miles. These were purchased by them from the Canada Pacific Railway syndicate, and paid for in cash. Notices of application to the Dominion Parliament at its next session are given as follows: For an act to incorporate "The Thunder Bay & Minnesota Railway Company," with power to build and operate a railway from at or near Prince Arthur's Landing to a point on Pigeon River, to bridge said river and connect with the projected line from Duluth to Pigeon River. For an act to incorporate William Gooderham, George A. Cox, John S. Newberry, James McMillan, John Proctor, B. P. Cheney and others as "The Sault Ste. Marie Bridge Company," with a capital stock of $1,000,000, and with power to build and work a bridge for railway and other purposes across the St. Mary River. For an act to incorporate "The Ottowa, Waddington & New York Railway and Bridge Company," with power to bridge the St. Lawrence at or near Ogden's Island, and to bridge the Ottawa River at or near Ottawa City.

## CONTRACTING, MISCELLANEOUS, ETC.

The Laredo, Tex., court-house and jail are to cost about $50,000.

The Kingston & Montreal Forwarding Company has a contract to bring 2,000 tons of rails for the Canada Pacific Railway from Montreal to Brockville, at $1.25 per ton.

The Northern Pacific Railroad Company has let a contract to Cameron, Halley & Rossiter for the construction of thirty miles of railroad from Duluth to Superior City. The work will be done next season.

Construction contracts for sections of the Canada Atlantic Railway in the vicinity of Ottawa have been let to the following persons: F. Kavanagh, section 80; Cluff & McVeigh, section 75; Geo. F. Thompson, sections 76 and 77; R. A. Sims, section 73; John O'Leary, section 79; J. B. Brannen & Co., section 71; John Porter & Co., section 72; Pierce Mansfield, section 78. The entire road is now under contract.

General Burt, who is constructing a new railroad between Saratoga and Schuylerville, has secured the entire right of way except through the farm of O. Shearer, near Victory Mills. On the 21st General Burt massed his men and ran the line through the Shearer lands. A commission of appraisers will settle the damages. Rails are now being laid and trains will run over the new railroad within five weeks.

The specifications for the new capitol building at Austin, Tex., have not yet been printed, and some parties representing intending bidders declare they positively will not have time to examine them and make their calculations with any safety before Dec. 1, when the bids are to be opened. They are very anxious to have another month, and it would appear that if the time is not granted competition may be cut off that might result in great profit to the State.

Five trestles are required for the cañyon, between Strawn and Ranger, on the Texas & Pacific Railroad. First trestle, 800 ft. long, 35 ft. high and single deck; second trestle, 1,800 ft. long, 45 ft. high, double deck; third trestle, 600 ft. long, 85 ft. high, three decker; fourth trestle, 800 ft. long, 95 ft. high, three decker. These combined trestles contain 2,500,000 ft. of lumber, costing $100,000. Eleven days only were consumed in putting them up, the bents having been framed at Fort Worth and hauled out to their places by wagons.

The Northern Pacific's construction trains are now operating five miles west of Powder River, across which a temporary bridge has been built. The most costly piece of road on the entire line is probably the forty miles of track west of Glendive, running along the Bad Land bluffs, next to the Yellowstone. It is expected that the maintenance of this will prove so expensive as to make necessary its abandonment and construction of the track on the south side of the river, which course would require two crossings of the Yellowstone. Work on the Mullon pass tunnel is delayed by the non-arrival of machinery and blasting-powder, but all preliminary preparations have been made. The tunnel is expected to cost $92 per linear foot, or $350,000 for the 3,800 feet.

A TOUGH STORY.—A sand or crevice blast was set in the bluff along Hell Gate River, where the grading was being done on the Northern Pacific Railway, near New Chicago, Montana. Seven kegs of powder were used for the main blast, and there were two smaller auxiliary blasts set with shorter fuse to open the crevice. The fuses were lighted, the men sought shelter, and there were two explosions in rapid succession. Nelson Bennett, the contractor, said: "The shots have gone off; let's go down," and started for the mine, followed by his bookkeeper and three laborers. Some one shouted: "The big shot isn't fired," but the five men went on until they stood over the 200 lbs. of powder. Bennett too late realized the situation, and exclaimed, with admirable coolness: "No, but here she goes and so do we;" and they went. The explosion was terrific, hurling 300 cu. yds. of rock—at least 1,000 tons—and the foolhardy five with it, far upward and out into the rushing river. That any of the unfortunates would survive was far from the thought of the spectators, but one by one the five men were fished out of the swift stream, bruised, bleeding, and horrible spectacles of humanity, but all alive and with sound bones. Bennett's first words were: "I made the best jump." He was thrown 120 feet by actual measurement. Railroad men and contractors familiar with such accidents consider the escape of these men the most remarkable on record. They say it would not have been so marvelous if the irruption had been of loose soil, or the men had fallen clear of the débris. But that they should have escaped with but insignificant cuts and bruises after such a vault through space and descent with and in the midst of 1,000 tons of solid granite is a fact without a parallel in the history of explosions.